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Coarse grained diamond grown at very high pressures; "superdeep" diamond

E Tomlinson (1), A P Jones (1), D Frost (2), A Beard (3), D Howell (1), and H J Millledge (1)

(1) Department of Earth Sciences, University College London, WC1E 6BT, UK (emma.tomlinson@ucl.ac.uk / Phone: +44-207-679-2363), (2) Bayerisches Geoinstitut, Universität Bayreuth, D-95440 Bayreuth, Germany, (3) School of Earth Sciences, Birkbeck College, London, WC1E 7HX, UK

Superdeep diamond contains remnants of mineral inclusions which suggest an origin 2 to 3 times deeper than normal mantle diamond, perhaps into the lower mantle. We report the first growth experiments for these deepest of all terrestrial samples. Multianvil press experiments were conducted over a range of pressures from 10-20 GPa and temperatures along a terrestrial mantle geotherm (T range $\sim$1800-2200^{o}C). Two different carbon-saturated mixtures were used (a) metallic Fe-Ni and (b) simple Mg-carbonate. Carbon was supplied as graphite, and no diamond seeds were used. All experiments were short duration (15 minutes), and all produced diamond examined by a variety of methods, including SEM/probe/CL for textures. We are surprised at the coarse-grain size; about half of the experiments produced very large platey crystals with sizes apparently restricted only by the capsule dimensions. The growth rate is approximately independent of the growth medium (carbon solvent). We interpret our results as evidence for several fundamental modes of diamond growth in the Earth. (1) The Fe-Ni system provides an analogue to efficient diamond growth during early planetary formation and liquid core-draining from meteoritic iron through a "sieve" of mantle silicates, and also overlaps with common synthetic diamond growth methods. It follows that FeNi metal donated to the core would likely be C-saturated. (2) Diamond grown from ambient mantle carbonate over a wide range of buffered redox states is a simple proxy for young diamond growth in the Earth, controlled by carbon supply. The results and experimental techniques will be presented in detail, including further analytical observations.